

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex rel.)
W.A. DREW EDMONDSON, in his)
capacity as ATTORNEY GENERAL OF)
THE STATE OF OKLAHOMA and)
OKLAHOMA SECRETARY OF THE)
ENVIRONMENT C. MILES TOLBERT,)
in his capacity as the TRUSTEE FOR)
NATURAL RESOURCES FOR THE)
STATE OF OKLAHOMA)

Plaintiff,)

vs.)

Case No. 4:05-cv-00329-GKF-PJC

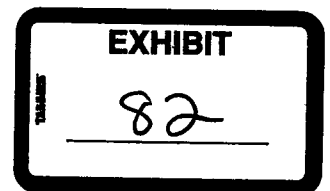
TYSON FOODS, TYSON POULTRY,)
INC., TYSON CHICKEN, INC., COBB-)
VANTRESS, INC., AVIAGEN, INC.,)
CAL-MAINE FOODS, INC., CAL-)
MAINE FARMS, INC., CARGILL, INC.,)
CARGILL TURKEY PRODUCTS, LLC,)
GEORGE'S, INC., GEORGE'S FARMS,)
INC., PETERSON FARMS, INC.,)
SIMMONS FOODS, INC., AND)
WILLOWBROOK FOODS, INC.)

Defendants.

AFFIDAVIT OF DR. CHRISTOPHER M. TEAF

The undersigned, Christopher M. Teaf, does hereby declare:

1. I received a Bachelor's degree in Biology (with Honors) from Pennsylvania State University and a Master's degree in Biological Science from Florida State University. I earned my Ph.D. in Toxicology from the University of Arkansas for Medical Sciences



(Little Rock, Arkansas) and conducted my research at the Division of Genetic Toxicology, National Center for Toxicological Research (Jefferson, Arkansas).

2. I presently hold positions as Associate Director at the Center for Biomedical & Toxicological Research and Waste Management at Florida State University (since 1983), as well as Director of Toxicology for the research firm of Hazardous Substance & Waste Management Research, Inc. since 1985 (President since 1989). I have held adjunct teaching appointments at the Florida State University / State University System Program in Medical Sciences, Florida A & M University College of Pharmacy and Pharmaceutical Sciences, and University of Arkansas for Medical Sciences.

3. I am board certified as a Fellow by the Academy of Toxicological Sciences.

4. My research and scientific advisory activities principally are in the areas of toxicology and health risk assessment for human exposure to occupational and/or environmental chemical and biological hazards.

5. For over 25 years, I have directed and conducted research projects and human health education activities for many agencies such as the World Health Organization (WHO), the North Atlantic Treaty Organization (NATO), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy (DOE), the U.S. Department of Agriculture (USDA), the federal Agency for Toxic Substances and Disease Registry (ATSDR), the Florida Department of Environmental Protection (FDEP), the Florida Department of Health (FDOH), the Florida Department of Community Affairs (FDCA), and many local governmental entities. These activities have been conducted in the United States, as well as Eastern Europe (e.g., Bulgaria, Czech Republic, Hungary, Poland), in Central Asia (e.g., Kazakhstan), and in Russia.

6. I have served as a peer reviewer for publications submitted to numerous scientific journals and presently serve on the editorial boards for several of these scientific journals. I am Senior Human Health Editor for the international journal *Human & Ecological Risk Assessment*. I have published many scientific papers, articles and book chapters concerning toxicological effects and risk evaluations related to occupational and environmental exposures and effects.

7. The scientific literature is clear in demonstrating that, despite what may be considered to be somewhat hostile conditions, bacteria can survive sufficiently well in the environment under a wide variety of circumstances to be moved, to persist, and to represent sources of human infection (e.g., Giddens and Barnett, 1980; Crane et al., 1980; Adamski, 1987; Adamski and Steele, 1988; Coyne and Blevins, 1995; Hartel et al., 2000; Gagliardi and Karns, 2000; Jamieson et. al., 2002; Tetra Tech, 2004; Davis et al. 2005; Ringbauer et al., 2006; PCIFAP, 2008.)

8. Land spreading of poultry waste has long been recognized as a major bacterial contamination source (Crane et al., 1980; Adamski, 1987; Adamski and Steele, 1988; PCIFAP, 2008). Spreading of waste material, a traditional agricultural waste disposal practice, becomes a major source of contamination because frequently it exceeds the rate at which wastes can be accommodated by or processed in agricultural ecosystems (Coyne and Blevins, 1995). Rainfall, specifically when it occurs shortly after land spreading, may then result in pathogen distribution by runoff from spread poultry waste or by leaching through the soil profile (Giddens and Barnett, 1980; Gagliardi and Karns, 2000; Fisher, 2008; Olsen, 2008), even if buffer zones are used correctly, which they frequently are not. This is rendered even more important by the fact that the recreational season for the Illinois River Watershed (IRW) overlaps with and immediately follows the rainy season, a period which is well within the survivability duration of the bacteria in question. The environmental survivability of bacteria can be on the order of several days to many months (Jamieson et. al., 2002; Tetra Tech, 2004; Davis et al. 2005). Runoff from waste-spread fields carries excess nutrients, pollutants, and pathogens to nearby waterways, which negatively affects surface water, groundwater, aquatic life, and human health; even months after land application of waste, fecal coliforms and *E. coli* can be resuspended from sediments and transported downstream (Coyne and Blevins, 1995; Hartel et al., 2000; Davis et al., 2005; Ringbauer et al., 2006).

9. The microbial condition of waterbodies in other parts of Oklahoma, or of other states, is not relevant to the health risks posed by conditions in the IRW. Whatever the source of bacteria elsewhere, a major contribution in the IRW is from land application of

poultry waste. An analysis of potential sources for fecal coliforms was conducted in a fashion consistent with that employed by USEPA and ODEQ for the six counties which share some portion of the Illinois River Watershed (Adair, Cherokee, Delaware and Sequoyah in OK; Benton, Washington in AR). That analysis considered fecal coliform contributions by a variety of categories for which data were available, including: domestic pets, deer/wildlife, failing septic systems, permitted point sources (i.e., NPDES outfalls), and livestock. The livestock category was further subdivided into groups by poultry, cattle/calves, horses/ponies, sheep/lambs, and swine. The aggregate fecal coliform load from poultry and from cattle/calves is approximately 5×10^{15} CFU/day, or 5,000,000,000,000,000 CFU/day each.

Several important conclusions can be drawn from this source contribution analysis, including the following:

- The categories of domestic pets, deer/wildlife, failing septic systems and point sources each contribute from 0.01% to 0.9% of total fecal coliform loading. Those contributions are not significant in comparison to the contribution from livestock;
- The livestock category alone contributes nearly 99% of total fecal coliform loading;
- Within the livestock category, poultry and cattle/calves each contribute just over 40% each of the total, swine contribute about 14% of the total, sheep/lambs contribute about 0.1% of the total, and horses/ponies contribute about 0.03% of total fecal coliform loading.

The leachability of poultry waste was on the order of 1 to 5 times greater than fresh cattle manure, and is likely to be even greater for dry manure based on the smaller particle sizes present in poultry waste (Olsen, 2008). Therefore, poultry waste is much more likely to leach components with the potential for adverse impacts from the site of application to nearby water sources, than is cattle manure.

10. Bacteria of human health significance, including *Campylobacter*, *Salmonella*, *Staphylococcus*, *Escherichia coli* and other important species, as well as bacterial "indicator organisms" such as fecal coliforms and enterococci, are present in poultry waste (e.g., Kelley et al., 1995; Jenkins et al., 2006; CDM, 2008; PCIFAP, 2008). The presence of microbial indicator organisms in surface and groundwater bodies globally

is used as evidence that other potentially dangerous bacteria such as *Campylobacter*, *Salmonella* and/or *Staphylococcus* also may be present, in addition to ancillary viruses and protozoa that are more difficult to monitor (e.g., *Cryptosporidium*). This assumption is considered to be relevant whether or not other analytical tests are conducted for those organisms.

11. The process of evaluating bacterial water quality according to the construct of “indicator organisms” is an accepted, well-established and long-running process that is employed by nearly all states and by many countries around the world. The U.S. EPA 303(d) List is prepared on a biennial basis as an ongoing obligation under the 1972 amendments to the Clean Water Act. It requires states to compile a list of water bodies that are “impaired” for various parameters, and to submit updated lists of the impaired water bodies to the U.S. EPA biennially (ODEQ, 2006; ODEQ, 2008). The U.S. EPA 303(d) list defines an “impaired” water body as one which does not meet state water quality standards, in this case applicable standards are those related to Primary Body Contact Recreation with surface water. The presence and magnitude of microbial indicator organisms, as used for impairment determinations, are commonly and widely accepted measures of the potential for presence and health significance of pathogens, including bacteria, viruses and protozoa (Toranzos et al., 2002; WHO, 2003; NRC, 2004; USEPA, 2005; Wade et al., 2006).

Contamination of surface water and groundwater supplies by bacteria has long been recognized as a human health concern in the United States and around the world. The 1986 U.S. EPA *Ambient Water Quality Criteria for Bacteria* provided historical context and recommendations concerning appropriate guidelines for microorganisms (USEPA, 1986). Subsequent refinements and updates to that guidance are represented by the *Implementation Guidance for Ambient Water Quality Criteria for Bacteria* (USEPA, 2003; USEPA, 2004). This health-based guidance fits into the operable “fishable/swimmable” goals of the Clean Water Act, which specifically requires water quality standards must “protect the public health and welfare, enhance the quality of water, and serve the purposes of this Act.” Microbiological contamination of water can be caused by bacteria, viruses, protozoa and other related organisms. The number and diversity of these potential contaminants has resulted in the development of practical assessment

and protection strategies which employ "indicator organisms" as surrogates for quantification of specific species in water bodies (Barrell et al., 2000; USEPA, 2003; National Research Council, 2004; USEPA, 2004). These indicator organisms, such as *Escherichia coli* (*E. coli*), enterococci, and fecal coliform bacteria, may not cause illness directly, but they have demonstrated characteristics which make them reliable indicators of other harmful pathogens in water (Wade et al., 2006). Although the most commonly reported illnesses associated with bathing in contaminated water typically are gastrointestinal in nature, other illnesses and conditions affecting the eyes, ears, skin and upper respiratory tract can occur as well. Essentially all local, state, and national health agencies employ one or more of the indicator organisms in their water quality management programs, and this is true internationally as well (WHO, 2000; USEPA, 2003; USEPA, 2004). Thus, there is consensus that the presence of these indicator organisms at levels greater than the health-based criteria or standards represents a human health threat.

The 2004 U.S. EPA *Implementation Guidance*, cited previously, provides detailed information regarding the basis for the environmental and health agency recommendations, including discussions on the epidemiology of microbiological disease related to water uses such as swimming, kayaking, water skiing, and other activities where direct contact and immersion in the water are likely. For *E. coli*, a geometric mean density of 126 organisms per 100 milliliters (ml) of water over a 30-day period was associated with an illness rate of 0.8%, or 8 illnesses per 1,000 recreational users (0.8%). As a short-term measure, this 0.8% illness rate was associated with bacterial counts of 236 per 100 ml as an upper limit. For the enterococci, a geometric mean of 33 organisms per 100 ml and an upper limit of 62 organisms per 100 ml were associated with the 0.8% illness rate (OAC, 2007). Above these threshold levels, the agency noted that illness rates rise sharply, and the health-based recommendation seeks to remain below that part of the statistical curve. The State of Oklahoma, along with essentially all other states, has adopted these or similar indicator organism criteria as a fundamental element of their water quality criteria for protection of human health. There is nothing unusual or unique about the State of Oklahoma approach.

12. While U.S. EPA has on occasion organized workshops and convened scientific meetings to discuss the issue of bacterial water quality and the use of various methods to assess such water quality (e.g., USEPA, 2007), those organizations and work groups have yielded only suggestions and potential alternatives. Multiple deadlines in the past have been proposed, not met, and re-proposed, for developing tangible revisions to the bacterial water quality criteria and assessment methods. This pattern clearly illustrates the difficulty and controversy associated with attempting to replace the existing system. To date, no viable alternative has been agreed upon or implemented, and the existing system remains in place both at the federal and state levels.

13. The Oklahoma State Department of Health (OSDH) maintains statistics regarding specific reportable diseases including diseases caused by bacteria such as *Campylobacter*, *Salmonella*, and *E. coli* 0157:H7, and by other microscopic parasites such as *Giardia* and *Cryptosporidium*. These organisms have been associated with poultry waste and often are also associated with contaminated drinking water, fecal material, and contact with birds. An evaluation of OSDH records for Oklahoma counties in the IRW shows that Adair County reported rates of campylobacteriosis considerably in excess of the state average for the period 1997 to 2005 (OSDH, 2006). Adair County makes up the largest portion of land area within the IRW. In addition, rates of salmonellosis reported between 1990-2005 also have periodically exceeded the average statewide incidence rate. The rate of salmonellosis in Sequoyah County was reported to exceed the state rate for all except three years during the period 1990 to 2001 (OSDH, 2006; OSDH, 2007). Furthermore, the data from the OSDH shows no associations between serotypes of the *Salmonella* bacterium. In addition to the lack of commonality between serotypes, no common relationships between individuals, demographic characteristics, or locations were identified, as would be expected from a single, large food-borne outbreak (OSDH, 2006).

14. Notwithstanding the statistics maintained by the OSDH, identification of individual illnesses is not a prerequisite to positing a reasonable likelihood of human health risk from bacterial contamination in the IRW. While the OSDH has not investigated any "outbreaks" with regard to the diseases discussed above, it cannot and

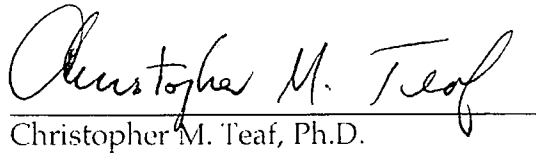
should not be presumed that incidents of infection are not occurring. Without question, tourism within the watershed is extensive, considering for example, that the general population of Adair County during the period 1990 to 2000 ranged from about 19,000 to 21,000 people (U.S. Census, 1990; U.S. Census, 2000) and at least an estimated 155,000 people use the IRW annually (Caneday, 2008). When using the CDC's guidelines for investigating an outbreak, a clustering of sickness must take place to warrant an investigation. This, therefore, would be very difficult to achieve under recreational use circumstances, recognizing that many tourists visit the Illinois River watershed from Arkansas, Kansas, Missouri, as well as other counties in Oklahoma. Lee et al. (2002) correctly noted that outbreak investigations were increasingly difficult to document when users convene onto one venue and then geographically disperse. This illustrates one possible reason why no focused investigations have been initiated for the IRW. Latency periods on the order of a day to a week (Mayo Clinic, 2008; CDC, 2008), depending on the bacterium, would surely affect reporting statistics if recreational users and tourists to the region are taken into account, and consideration is given to the likelihood of returning to their homes after visiting the IRW. Additionally, outbreaks associated with some infective organisms are less likely to be investigated than acute diseases characterized by short incubation periods, serious illness requiring medical treatment, and those having recognized etiologies (Lee et al., 2002; Blackburn et al., 2004). Individual sensitivity and enhanced susceptibility among groups such as children, the elderly, and the immuno-compromised, further complicates the effectiveness and applicability of disease surveillance (WHO, 2003; NRC, 2004).

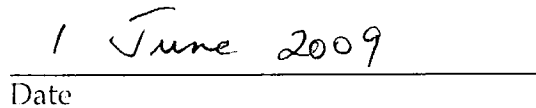
15. It is clear that many diseases are commonly under-reported, given the limitations of the passive disease surveillance systems presently in place in Oklahoma and elsewhere. Multiple factors play a role in whether disease outbreaks are recognized, investigated, and/or reported, which typically will result in under-reporting of the true illness rate (Lee et al., 2002; Blackburn et al., 2004; Liang et al., 2006; Craun & Calderon, 2006). Multiple studies (Lee et al., 2002; Yoder et al., 2004; Blackburn et al., 2004; Liang et al., 2006) have concluded that data which are collected most commonly pertain to "outbreaks," with no mechanism to include seemingly sporadic cases, and therefore the data do not necessarily represent actual endemic trends with waterborne illnesses. The

observations already available concerning disease occurrence in northeastern Oklahoma underscore the potential for increases in infectious diseases related to land disposal of poultry waste in large quantities.

16. Attachment A to this Affidavit presents the references cited herein.

17. I declare under penalty of perjury, under the laws of the United States of America, that the foregoing is true and correct.


Christopher M. Teaf, Ph.D.


Date

ATTACHMENT A

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